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(54) Title: THERMALLY CONDUCTIVE ADHESIVE COMPOSITION AND PROCESS FOR DEVICE ATTACHMENT

(57) Abstract: Thermally conductive, sinterable, adhesive compositions, free of fugitive solvents, that include a powder of a relatively high melting point metal or metal alloy, a powder of a relatively low melting point metal or metal alloy powder and a thermally curable adhesive flux composition that comprises (i) a polymerizable fluxing agent; (ii) an inerting agent to react with the fluxing agent at elevated temperature, rendering it inert. The fluxing agent preferably comprises a compound with formula RCOOH, wherein R comprises a moiety having one or more polymerizable carbon-carbon double bonds. Optionally, the inventive compositions also include (a) a diluent that is capable of polymerizing with the fluxing agent's polymerizable carbon-carbon double bonds; (b) free radical initiators; (c) a curable resin; and (d) crosslinking agents and accelerators. The compositions can be applied directly onto the surfaces of devices to be joined mechanically and/or electrically and are ideally suited for semiconductor die attachment. During heating, the fluxing agent promotes wetting of the high melting point powder by the molten low melting point powder, causing liquid phase sintering of the powders. The fluxing agent also promotes wetting of the metallizations on the die and substrate by the molten low melting point alloy, providing improved thermal conductivity. Simultaneously, the fluxing agent itself crosslinks to further mechanically bond the adherent surfaces. The absence of fugitive solvents creates a void-free bond.

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US04/09886

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : C08K 03/08; C09J 04/02, 163/00, 163/02
US CL : 252/183.11; 523/458

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 252/183.11; 523/458

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
CAS Online: Files REG and CAPLUS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,985,456 A (ZHOU et al.) 16 November 1999 (16.11.1999), column 4, lines 14-18; column 8, lines 34-37 and column 9, lines 47-63.	1-3 and 5
A	PCT WO/8/08362 A1 (CRAIG) 26 February 1998 (26.02.1998), page 9, line 28 to page 10, line 4; page 12, lines 20-33 and page 14.	1-3 and 5
A	US 5,652,042 A (KAWAKITA et al.) 29 July 1997 (29.07.1997), column 2, lines 14-34.	1-3 and 5
A	US 6,458,472 A (KONARSKI et al.) 01 October 2002 (01.10.2002), column 4, lines 26-31 and column 5, lines 32-42.	1-3 and 5

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

* Special categories of cited documents:	
"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"B" earlier application or patent published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	"&" document member of the same patent family

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INTERNATIONAL SEARCH REPORT

International application No.

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Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

An Invitation to Pay Additional Fees, Form PCT/ISA/206, setting forth a lack of unity of invention was mailed on 04 October 2004. No response has been received within the 15 day response period from the date of mailing. Accordingly, no additional fees have been paid and only the first invention of claims 1-5 is hereby considered.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.: 1-5

Remark on Protest

☐
☐

The additional search fees were accompanied by the applicant's protest.

No protest accompanied the payment of additional search fees.